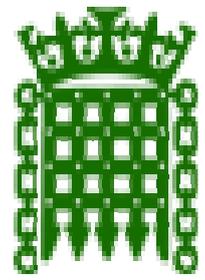


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# All Party Parliamentary Light Rail Group

House of Commons London SW1A 0AA

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## Aarhus LRT: Driving development in Eastern Jutland

Aarhus is currently developing Denmark's inaugural light rail project which is on course to open in 2017 to coincide with the city becoming the year's European Capital of Culture

Lying on the gentle slopes of the Egådalen valley, 7km north of Denmark's second city Aarhus, is the village of Lisbjerg. With a population of just 839, the village is surrounded by fields where herds of cows sit lazily watching the traffic whizz to and from the nearby city.

While it is sedate scene, development plans for the area mean that Egådalen's livestock will be grazing somewhere else very soon. On the other side of the valley, cranes standing over the new white university hospital building under construction in Skejby, on the perimeter of Aarhus, hint at the work already underway. Indeed, running down from the hospital are some of the first tracks laid for Aarhus' inaugural light rail project, construction of which began in 2013.

The tracks snake through the fields crossing a new 380m-long bridge over the existing highway before reaching Lisbjerg's outer limits. Here they stop briefly before returning as the line heads east to the new town of Nye.

Standing at the future junction of the short branch to Lisbjergskolen where a crew of construction workers is busy digging foundations on a dull September afternoon, Mr Claus Rehfeld Moshøj, Letbanen managing director, tells IRJ that the new railway is driving developments in this area of the city.

"The vision is to build new homes here, served by the light rail line, which will provide a direct link into the city centre, meeting demand for housing and mobility," Rehfeld says. "The idea is to build dense housing consisting of row houses, which have a little front and back garden and are increasingly popular in Denmark, and are designed to spur the development of shops and other businesses. That's the vision at the moment and we are just waiting for it to be approved. One developer is already onboard and purchased land, and we expect the remaining land to go up for sale soon."

The developments are expected to serve 20,000 new residents in Lisbjerg and 10,000 in Nye as greater Aarhus' population increases to 375,000, and its housing stock by 50,000 to 200,000 by 2030. The city is expected to create another 50,000 jobs during the period, taking its total to 230,000 while its already sizable student population is expected to expand from 40,000 to 60,000 by the end of the next decade.

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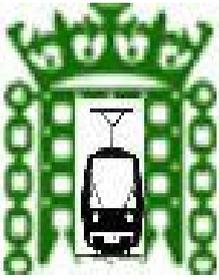
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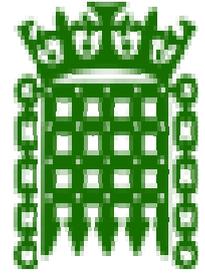
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Aarhus is Scandinavia's second most congested city and light rail is considered critical to alleviate its traffic problems as well as support growth across the greater Aarhus region, which is home to 1.2 million people, and stretches from Randers in the north to Horsens in the south, Grenaa in the east and Silkeborg in the west.



Letbanen was formed as a public company in 2011 to manage the DKr 3.5bn (\$US 485.3m) first phase of the network development project, which Rehfeld is on schedule. The aim is to deliver a 12km new light rail line with 17 stations through the city centre and a 98km tram-train service to Grenaa and Odder with 33 stops by the middle of 2017 when Aarhus is the European Capital of Culture.

Funding for the scheme is provided by the Danish State (47%), the municipality (47.8%) and the regional government (5.2%). The project encompasses 19 civil works contracts ranging from bridge construction and line foundations which were awarded to predominately Danish companies and worth on average around DKr 5-20m each, and a railway systems contract. This €292m agreement includes signalling, electrification and rolling stock supply and was awarded to the Asal consortium of Ansaldo STS, GCF and Stadler in 2014.

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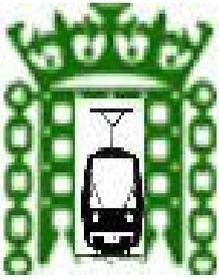
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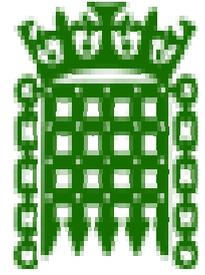
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As well as linking the new hospital with Lisbjerg and Nye, the line will serve the city's university campus on a 3km stretch along Randersvej from Navitas at Aarhus harbour to Nehrus Alle from where the line heads west to the hospital site. Ground works on Randersvej have involved digging a trench through the centre of the road, which was widened a few years ago to accommodate a dedicated bus lane. Work is set to be completed this month with track works due to start soon after and conclude by April or May 2016.

In addition to construction of new street-running light rail infrastructure, the project includes converting 69km of existing heavy rail line between Grenaa and Aarhus, and 26.5km between Aarhus and Odder for electric tram-train operation.

Services on these lines were previously operated by two separate railways, the Odderbanen and Grenaaabanen. But following their amalgamation, and the provision of a single through service by Danish State Railways (DSB), ridership rose by 60%. Rehfeld expects this to increase further once the tram-train and light rail service is operational, with projections of 39,000 passengers using the service daily. However, he admits this won't be enough to convince everyone to leave their car at home.

## Important backbone

"There is currently a lack of well functioning public infrastructure in eastern Jutland so this project is an important backbone to improve the situation," Rehfeld says. "The capacity will be enough to serve the inner city, but we have a problem on the heavy rail line because there isn't sufficient infrastructure available. Much of the line is single track and it is unlikely that funding will be available to double-track the entire line. The plan is to find ways to optimise the current system and look at clever solutions to make the single-track line as efficient as possible."

A mixed fleet of 14 Variobahn LRVs supplied by Stadler Pankow and 12 Tango tram-trains from Stadler Altenrhein, which are currently in production, will operate the new service.

The first body shells for the vehicles were completed last month and their design is intended to provide an easily recognisable identity for the network. The grey exterior livery with a hint of blue reflects the line's proximity to the sea, which is broken up with elements of bright red, Letbanen's signature colour. Danish textile company Kvadrat is providing seat coverings, with the company developing the design for Aarhus in cooperation with Danish design house AVPD.

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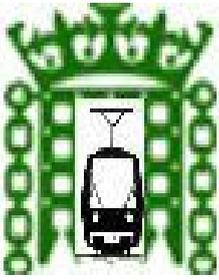
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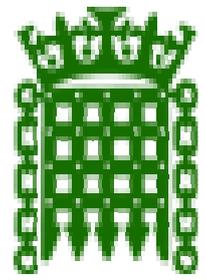


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The LRVs are the same as the Stadler vehicles already in use in Bergen and Croydon. However, Rehfeld says several modifications have been made for Aarhus and that Letbanen has advised on certain sub-suppliers to use.

"We found that the insides of the vehicles used in Bergen suffer from condensation, and with rain in this area on three to four days every week, we wanted to avoid this," Rehfeld says. "The solution is to use double-glazed windows which keep the condensation out even when people are using the tram when they are wet."

Maintenance of the vehicles will take place at a new facility off the main line, west of Aarhus central station. A new Dkr 80m bridge has already been built to serve the depot from the main line and construction of foundations of the future building is underway. Under its contract, Stadler will maintain the vehicles for six years at the facility with an option for a three-year extension. "We considered a lot of different options for this, and while other arrangements work well for other operators, we feel this will work for us," Rehfeld says.

Keolis secured an operations contract in May 2015 and it is also responsible for training the 80 drivers required for the network who will be recruited next year.

Up to six LRVs and two tram-trains from Odder will serve the central portion of the new light rail line between Aarhus Central and Aarhus University Hospital every hour, offering a journey time of 17 minutes. Four of these services will continue to Lisbjerg and two to Lystrup. Two tram-train services per hour will travel between Marslet and Ryomgard using the heavy-rail alignment, with both continuing to Grenaa during peak hours and one at other times. One complete Odder - Grenaa service will operate hourly during the peak.

The new depot will house the network's operations control centre as well as bus dispatchers and traffic management to provide an operations hubs for the city. Operation of the LRVs and tram-trains will also benefit from a new radar vehicle detection system, which will control traffic signals, providing priority to light rail and minimising disruption to services.

Mr Justin Caton, Letbanen's project director, says the company is planning to adopt similar level crossing detection system to that used in Lyon, where Tango vehicles are also in service. This system shortens waiting times at intersections by altering traditional trigger points, an important consideration given that there are 50 level crossings on the heavy-rail section.

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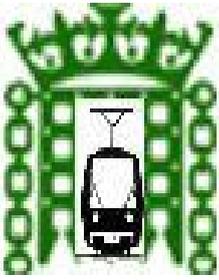
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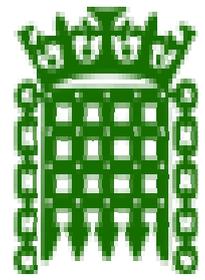


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He adds that operators will be aware of the precise location of any train through a vehicle detection system, which utilises the train's Wi-Fi system and is based on 3G or 4G networks where available, and GPS elsewhere. The system will provide real-time updates of any delays to the service and relay this information to passenger information systems.

The signalling project consists of two elements.

While Ansaldo STS is supplying an ATP system with train detection based on axle counters for the new tram-train lines, the project also includes immunisation work on Banedanmark main lines in Aarhus because of potential interference to legacy signalling equipment caused by Letbanen's electrification.

Caton says that with Banedanmark's nationwide ERTMS rollout coming to Aarhus in 2018-2020, a hybrid solution was developed to replace the legacy signalling track circuits in order to significantly reduce the cost of converting the system. "This is a smart solution which provides value for money to the Danish taxpayer

," Caton says.

The project was partly funded by the EU through the Elena programme and Caton say it will consists of changing all the existing trackside dc track circuits with ac relays, and swapping track circuits with dc relays. Track circuits located further away will remain in place after Letbanen proved that no changes are required. The dc relay solution uses double-end fed relays consisting of another dc relay at the end of the track circuit which raises the immunity level. While the cost of the ac and dc relays are the same, the control system for the ac relay is very complex and expensive, with the dc relay solution 20% of the price of the equivalent ac solution.

## Electrification

The electrification programme for both the heavy rail and new light rail sections consists of installing a 750V dc system.

Project manager Mr Jakob Bisgaard Neromante says that work to install 3000 masts and the 30 transformers required for the heavy rail line will begin in December between 23.00 and 05.30 and at weekends. This will continue until August 28 2016 when the line will be closed completely ahead of the start of testing the following month. Line tests will begin in January or February 2017.

Beyond 2017.

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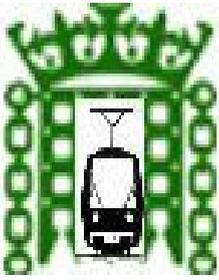
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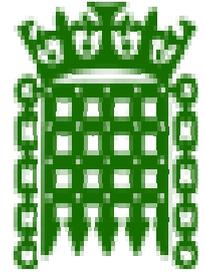
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Aarhus is looking to expand its light rail network further, specifically through three additional projects. The first is the 8.2km northwest extension of the branch to Lisberg Vest to Hinnerup to interchange with Aarhus - Randers regional services and where a new park and ride station will be built next to the E45 motorway.

The project will add another seven stations to the network and is estimated to cost DKr 596m.

The second project is an entirely new 7.7km line from Aarhus harbour via Aarhus Central to Brabrand, which is estimated to cost DKr 718m and includes 15-17 stations. The third is an 11.6km link southwest from Aarhus to Hasselager. This project is estimated to cost DKr 906m and will have 16 stations but is not likely to move ahead until 2019-2020.

Rehfeld says the priority is to develop the Brabrand and Hinnerup lines first as they will solve traffic challenges in the area and drive urban development. In particular, the Brabrand line is a central pillar of the strategy to develop west Aarhus as it will serve three of the city's largest public housing developments in Brabrand as well as the Old Town and a shopping mall.

The local government's decision to grant approval to proceed with a public consultation for the projects last month is the first major hurdle cleared. This will last up until December and will be followed by a two-year environmental impact assessment, after which design tenders will be called.

Ignored for so long, light rail is now the centrepiece of future transport plans and ambitions to revitalise new and forgotten areas of Aarhus. It's a similar story in projects currently under development in Odense and Aalborg, and in the west of Copenhagen, although construction is yet to start here. Aarhus will be the first, and with developers lining up to purchase land adjacent to the new line, the signs are that it will deliver the benefits promised.

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Written by Kevin Smith

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